U. S. FOREST SERVICE

RESEARCH NOTE NC-90

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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Variation in Density of Sugar Maple Sapwood and Heartwood

ABSTRACT. — Provides data on the variation in density and the proportion of sugar maple sapwood and heartwood by height in the tree.

OXFORD: 812.31:165.53:176.1 *Acer Saccharum*

The density of wood under normal conditions is a good indicator of strength and fiber yield. The within-stem variation in density (both vertically and radially) has been studied extensively for softwoods. However, much less information is available for hardwoods. Apparently, data on density variation was needed primarily for pulpwood and construction lumber, products that have traditionally been softwood. The increased use of hardwoods for these products is creating a need for density information for hardwoods.

It has been commonly believed that density decreases with increasing height. This view is well documented for certain softwoods although contradictory data are available (Anderson 1965, Paul 1963). Much less is known about hardwoods (Hamilton 1961, Paul 1934), although Barefoot (1963) found that the density of yellow poplar was higher at the base of the tree than it was at 17 feet above ground.

We studied (1) the variation in density of sugar maple sapwood and heartwood by height, (2) the percent of sapwood at various heights, and (3) the variation in combined heartwood and sapwood density by height.

METHODS

Ninety trees averaging 18 inches d.b.h. and 190 years old were selected for study in Upper Michigan. The trees were felled and bucked into 8-foot lengths to a top diameter of 6 inches or to the point of breakup into the crown. Two-inch thick discs were cut from the butt of each log and sent to the U.S. Forest Products Laboratory at Madison, Wisconsin, for measurement of basic density (based on volume green and weight ovendry) of both the sapwood and the heartwood.

RESULTS

Our findings show that the average density of sugar maple sapwood and heartwood decreases rapidly between the stump (1 foot) and 16 feet, and begins to level off between 16 and 32 feet. Sapwood density is 1.8 pounds per cubic foot greater at 0 feet than at 16 feet, while the density at 16 feet is only 0.1 pounds per cubic foot greater than at 32 feet. For heartwood, the density, is 2.6 pounds per cubic foot greater at 0 feet than at 16 feet, and only 0.4 greater at 16 feet than at 32 feet. Average density of the heartwood is greater than that of the sapwood, the difference ranging from 2.9 pounds per cubic foot at 0 feet to only 1.8 pounds per cubic foot at 32 feet.

The combined density was evaluated by weighting the densities of the sapwood and heartwood by the relative proportion of each, for each tree and height. Sapwood width and disc diameter were used to compute the percentage of sapwood at each height. The average percentages are listed below:

Height (from 1-foot stump) (Feet)	*Sapwood (Percent)*
0	84
8	76
16	76
24	76
32	68

On the average, the combined heartwood and sapwood density is 1.7 pounds per cubic foot greater at 0 feet than at 16 feet, with little difference in density between 16 and 32 feet (fig. 1).

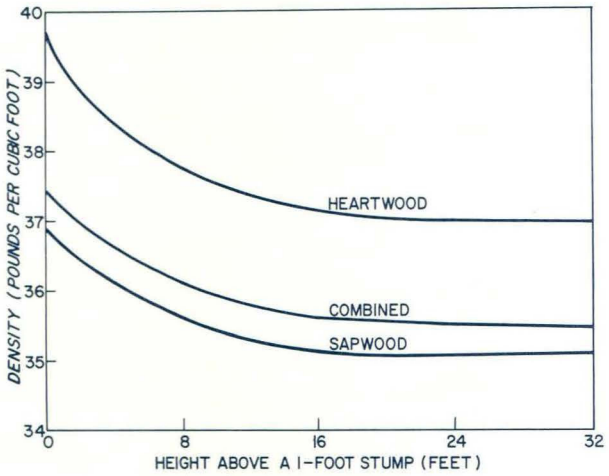

Figure 1.—Density of sugar maple sapwood and heartwood and combined sapwood-heartwood by height level.

Sapwood density decreases 5 percent from 0 to 16 feet, while the heartwood density decreases 7 percent.

The results of this study tend to support the view, developed from certain softwoods, that density decreases up the stem. However, this decrease appears, for Upper Michigan sugar maple, to be limited to the first 16 feet.

LITERATURE CITED

Anderson, E. A. 1965. Proceedings of the symposium on density – a key to wood quality, May 4-6, Forest Products Laboratory, Madison.

Barefoot, A. C., Jr. 1963. Selected wood characteristics of young yellow poplar. Part I. Forest Prod. J. 13(6): 233-239.

Hamilton, J. R. 1961. Variation of wood properties in southern red oak. Forest Prod. J. 11(6): 267-271.

Paul, B. H., and Marts, R. O. 1934. Growth, specific gravity, and shrinkage of twelve delta hardwoods. J. Forest. 32 (8):861-873.

Paul, B. H. 1963. The application of silverculture in controlling the specific gravity of wood. U.S. Dep. of Agr., Tech. Bull. 1288, 97 p., illus.

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